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USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING

No. 73

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AMPLIFIERS

UDC 621.375.4

PHASE-FREQUENCY CHARACTERISTICS OF THE HYBRID INTEGRATED CIRCUITS OF BALANCED AMPLIFIERS

Moscow ELEKTROSVYAZ' in Russian No 5, May 80 pp 55-56 manuscript received 31 Jan 79

PETROV, G. V.

[Abstract] The phase-frequency characteristics (PFC) of the hybrid integrated circuits of balanced amplifiers are investigated. A block diagram is presented of a balanced microwave band amplifier which contains two individual amplifiers and two directional couplers, to the two terminals of which load resistors are connected. The resistors have reflection factors Γ_2 and Γ_3. The signal is fed to the input terminals and removed from the output terminals. Three-decibel directional couplers based on connected microstrip lines are used in the amplifier. The effect of various factors on the linearity of the amplifiers is considered. It is shown that if individual amplifiers with fixed and linear phases in the frequency band are used, then the PFC of the balanced amplifier also turn out to be linear. Figures 4; tables 3; references: 4 Russian.
[280-6415]

UDC 621.375.4

TEMPERATURE STABILIZATION OF THE PHASE-FREQUENCY CHARACTERISTIC OF A MICROMINIATURE AMPLIFIER

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 89-90 manuscript received 23 Oct 78

BURYAK, V. A., KAPITANOV, N. N. and ZAYARNYY, P. P.

[Abstract] The problem is discussed of stabilizing the phase-frequency characteristic of an amplifier designed from K2US281 microcircuits with a cascade hookup in a common-emitter circuit. Temperature stability of the phase-frequency characteristic of amplifiers is required in multichannel phase measuring equipment, for example. The heat stabilization resistors used with series 228, 235 and 265 microcircuits, for example, do not always result in the stability of the phase-frequency characteristic of an amplifier. The problem of stabilization is solved here by taking this fact into account. An expression is obtained for the relative temperature instability of the phase-frequency characteristic of an amplifier. Two factors, D_1 and D_2, are arrived at, which determine the sensitivity of the phase-frequency characteristic to the influence of temperature, whereby D_1 is for the direct case and D_2 for the indirect, i.e., via a change in I_{k0}, the collector's back current. For temperatures below 273°K the change in I_{k0} is insignificant and the instability of the phase-frequency characteristic is determined by the value of D_1. The influence of D_2 must be taken into account for temperatures above 273°K, but its weight is not too high because of the triviality of the instability factor for the collector's back current as well as for I_{k0} for the silicon transistors used in the K2US281 microcircuit. Curves calculated by means of a digital computer are presented, making it possible to determine the value of the capacitance in the negative feedback loop and the optimal value of the load for a specific operating frequency. By optimal selection of a value for γ, representing a factor taking the magnitude of the load into account, with which D_1 will be minimal, it is possible to achieve stability of the phase over the range required for a specific temperature range for different correction factors and different values of x, where $x = \omega\tau$. The calculation sequence is: Having selected the correction factor for a frequency of $\omega = x/\tau$, a determination is made of γ, the factor taking into account the magnitude of the load, from the curves presented. Taking into account D_1 and D_2, from two other sets of curves presented an estimate is made of the instability of the phase for a specific temperature range. If the relative temperature instability of the phase-frequency characteristic does not exceed the permissible values, a determination is made of the capacitance in the feedback loop and of the load in the collector. Otherwise, another correction factor is selected and the calculation is repeated. An experimental study was made of a three-stage amplifier and calculated and experimental curves are given for the dependence of instability of the phase shift of temperature. Good agreement is shown. Figures 2; references: 6 Russian.
[282-8831]

UDC 621.375.121

USE OF A SLIDING APPROXIMATION INTERVAL FOR ANALYZING THE PROPERTIES AND SYNTHESIZING THE PARAMETERS OF BROADBAND AMPLIFIERS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 61-63 manuscript received 23 Jul 79

KUZ'MIN, Yu. G. and SMIRNOV, R. A.

[Abstract] A method of approximation is suggested which makes it possible without using a computer to analyze and synthesize the parameters of amplifiers and other systems with discrete parameters whose frequency properties are described by an expression of the type $M^2 = \sum_{i=1}^{m} a_i x^i / \sum_{i=1}^{n} b_i x^i$, where $m < n$ and $x = \Omega^2$ and M^2 equals the square of the frequency distortion factor. The method is based on local approximation of the amplitude-frequency or phase-frequency characteristic in a specific frequency interval. The telescopic shift method for Chebyshev polynomials makes it possible to approximate the square of the frequency distortion factor in the vicinity of the upper-limit frequency by means of the polynomial fraction $M^2 = (A_1 + A_2x)/(B_1 + B_2x)$ and in the region of extreme values by the fraction $M^2 = (A_1 + A_2x)/(B_1 + B_2x + B_3x^2)$. The approximation error varies with a shift in the interval in which the telescopic shift is carried out. The possibilities of using this method are limited because the percentage error is not constant within the interval and is not the minimum possible in this interval. Here is introduced the concept of the local dynamic approximation interval (LDIA), which makes it possible to eliminate these disadvantages and to approximate frequency characteristics with any preassigned accuracy. By the LDIA is meant the interval whose width varies as a function of the position of the starting point of the interval in such a manner that the percentage approximation error is always a minimax and is determined only by index k and the power of the polynomial, $P_{kr}(x)$, where the percentage approximation error equals $\delta_0 = [x^k - P_{kr}(x)]/x^k$. By using the dynamic approximation interval suggested it is possible to study the shape of the amplitude-frequency characteristic and easily to determine its extrema. By equating M^2 to one, an equation is arrived at from which according to the Lagrange theorem the upper and lower limits of the amplitude-frequency characteristic's extrema are found. For successful application of the LDIA method it is necessary that the section of the amplitude-frequency characteristic considered fall within the interval. This does not always occur on the first attempt, but the approximate answer obtained shows in which direction it is necessary to shift the interval. Tables 2; references: 3 Russian.

[282-8831]

ANTENNAS

UDC 621.396.6

STABILITY LIMITS OF THE PROBLEM OF SYNTHESIZING AN ANTENNA ARRAY

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 86-88 manuscript received 24 Apr 79

ZHUKOV, V. B.

[Abstract] A specific directivity pattern, D_0, in the aperture of a multi-element broadside antenna can be represented mathematically by approximating this pattern by means of a specific polynomial in the space of the metric selected: $D(\theta) = \sum_{n=0}^{N} C_n e^{ikz_n \cos\theta}$, where C_n represents excitation coefficients and z_n coordinates of elements of the array on axis z, N + 1 is the number of elements, θ is the spherical coordinate supplementary to the angle of position and k is the wave number. According to the variational theory of the synthesis of antennas, coefficients C_n are determined from a regularized system of equations with a regularization parameter of α. With the absence of a regularization parameter this system of equations with a fixed level of input data errors and computation accuracy can have such high values of conditionality numbers that it is impossible to guarantee any accuracy for the solution. In an unstable system of this sort slight changes in calculation conditions can result in impermissibly high errors in the solution. When using this system of equations for solving problems relating to the synthesis of arrays, the developer must know beforehand the conditions under which stability is lost. It is desirable to obtain the information necessary without the computation of conditionality numbers for estimating stability on their basis which requires considerable experience. It is desirable to arrive at a solution to the problem of synthesizing an array without regularization, i.e., to have precomputed values of the number of elements, N, for different distances between elements, whereby it is possible to arrive at a solution with a degree of accuracy acceptable for practical purposes. The procedure is described here of using coefficients for the excitation of an equidistant broadside uniformly excited uniform array as the reference and of determining N numbers whereby the minimax deviations of coefficients calculated from the system of equations mentioned above, with normalization for reference values, do not exceed 10 percent. The influence of distributions of excitation differing from the reference is taken into account by the addition of corrections. Values of deviations arrived at are used to evaluate the

validity of the solution to the problem of synthesizing an antenna array without regularization. Graphs are arrived at which can be used for an approximate estimate of the limits of stability of the problem of synthesizing an antenna array. Figures 3; references: 3 Russian.
[282-8831]

UDC 621.396.67:621.397.13

NEW GENERATION OF TRANSMISSION ANTENNAS FOR IV-V TELEVISION BAND

Moscow ELEKTROSVYAZ' in Russian No 5, May 80 pp 33-37 manuscript received 6 May 79

BRADACH, I., KOZLIK, M. and KADLETS, Y., Czechoslovak Socialist Republic

[Abstract] A research group of the antenna division of the Tesla plant in Czechoslovakia has created a new generation of antennas for the IV-V television band. The design and electrical characteristics of the ANR-450 series of television transmission antenna systems are described, as well as the feed and lightning protection systems. It is concluded that the antenna systems of the ANR-450 series are optimum for the majority of transmitters. They can be used in any locality and with any climate. Figures 14; tables 1.
[280-6415]

UDC 621.396.677

ANTENNA DIRECTOR IN THE FORM OF A PLANE SCREEN OF POLYGONAL FORM

Moscow ELEKTROSVYAZ' in Russian No 5, May 80 pp 38-41 manuscript received 19 Jun 79

NEPOMNYASHCHIY, I. L. and YAMPOL'SKIY, V. G.

[Abstract] A screen (antenna director) which shades the second Fresnel region of an antenna is investigated. Construction of the screen is fulfilled with interior and exterior contours in the form of regular polygons. Such a screen can be assembled from identical sections with rectilinear edges. The noise immunity of an antenna director is studied. The efficiency of such screens and their long-range fringe radiation is compared

with that of circular screens. The results of the investigations show that an antenna director, the radiopaque antenna array of which is fulfilled in the form of a regular polygon or hexagon, provides a power gain 0.3--0.5 db less than the gain of a circular screen. However, the considerably better noise-immunity properties of such screens and the relative simplicity of production undoubtedly makes them more promising for practical introduction. Figures 5; tables 1; references 3: 2 Russian, 1 Western.
[280-6415]

UDC 621.396.677.49

OPTIMAL LAW FOR CONTROL OF THE WEIGHTING FACTORS OF ADAPTIVE ANTENNAS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 34-37 manuscript received 5 Mar 79

LITVINOV, O. S.

[Abstract] The function of an adaptive antenna is to suppress a noise signal arriving from an unknown direction. These antennas often employ adaptive antenna arrays in which the weighting factors in the channels are so selected that the ratio of the power of the useful signal, P_s, arriving from a specific direction to the total power of interference and intrinsic noise, P_{sh}, will be maximum. This study is devoted to deriving an algorithm for selecting weighting factors in channels of an adaptive antenna array so that P_s/P_{sh} will be maximum. An algorithm of this sort was derived by Applebaum (1976), but on the assumption that the maximum signal-to-noise ratio is achieved with the identity of uncorrelated noise in different channels of the antenna array and on the basis of a theoretical antenna array in whose inputs the useful and interfering signals and the intrinsic noise and the weighting factors are obtained by means of a linear non-unitary transformation. A demonstration is given here of the fact that it is possible to do away with Applebaum's assumption if the theory of quadratic forms is applied successively. The adaptive antenna discussed is an N-element antenna array with any arrangement of elements. The stationary mode of operation of the adaptive array is considered, when the weighting factors have reached their maximum values as the result of a number of cycles of adaptation caused by a specific noise situation, i.e., the number of noise sources, their power and location in relation to the array. The level of the useful signal and external interference signal is related to the level of intrinsic noise in the array's channels. The case is considered, when signals arrive at the array from several external noise sources. An expression is derived for the power of the useful signal and it is demonstrated that this signal is a quadratic form in terms of the

components of vector w, where w represents a matrix column composed of weighting factors. To demonstrate this, the expression for the power of the useful signal is rewritten in terms of components of w. It is demonstrated further that the expression for the mean power of the interfering signal is also a quadratic form. It is shown that P_s and P_{sh} are Hermite quadratic forms. An equation is derived for ratio P_s/P_{sh}. On the condition of maximum P_s/P_{sh}, a law is arrived at for optimal control of components of the weighting vector. An optimal law for the selection of weighting factors is derived also for the case when the purpose of processing the signal in the antenna array is the achievement of a certain compromise between different parameters of the directivity pattern and not the maximum of P_s/P_{sh} when receiving a signal from a specific direction. Figures 1; references 3: 1 Russian, 2 Western.
[282-8831]

CERTAIN ASPECTS OF COMPUTER HARD AND SOFT WARE: CONTROL, AUTOMATION, TELEMECHANICS, TELEMETERING, MACHINE DESIGNING AND PLANNING

UDC 621.372.061

SYMBOLIC-NUMERICAL ANALYSIS OF ELECTRONIC CIRCUITS USING A TABLE COMPUTER

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 6, Jun 80 pp 78-80
manuscript received 27 Nov 79

PODROYZHEK, V., candidate of technical sciences, coworker, Department of Radio Electronics, Polytechnical Institute (Vysoke Uceni Technicke) in Brno, Czechoslovakian Socialist Republic

[Abstract] The method of signal graphs is suitable for analysis of linear electronic circuits with the aid of computers, in particular with the use of small computers with limited speed of response and capacity of the memory device. During the composition of the program of analysis described in the present paper, a signal graph in generalized form was used as a mathematical model of an electronic circuit. A procedure is considered which is essentially realized in the program of symbolic-numerical analysis of linear circuits SNALOOG, composed in BASIC language for the table computer Type HR9830A. The program computes a specified function of the circuit as the ratio of two polynomials of complex frequency with numerical coefficients or by letter presentation of all or some parameters of the elements of the circuit analyzed. The circuit analyzed can contain any passive or active elements with one and two independent inputs. The SNALOOG program consists of four subprograms. The programs described make it possible to analyze circuits, the signal graphs of which have not more than 70 branches. Figures 2; references 7: 4 Czech, 3 Western.
[295-6415]

UDC 621.396.019.3

PARAMETER OPTIMIZATION OF MAGNETIC MEMORIES WITH A RECTANGULAR HYSTERESIS LOOP

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23, No 6, Jun 80 pp 61-65 manuscript received 6 Jun 79

BOGATYKH, A. Ye. and VERBOV, V. F., Rostov-na-Donu

[Abstract] In spite of the wide use of memory units constructed on the basis of magnetic elements with a rectangular hysteresis loop, the problem of optimizing choice of the current parameters of memories is still very little reflected in the literature. With the use of an extremal uniform-distribution criterion, the present paper establishes the optimum dependences between the current parameters and the characteristics of the magnetic materials of memory cores. The method presented for constructing the ranges of efficiency of the magnetic memories, as well as dependences derived in the work, make it possible to select rapidly the optimum value of the current parameters during solution of various problems encountered in engineering practice. An example of the use of the method is presented. Figures 4; references: 2 Russian.
[293-6415]

UDC 621.396.2

SOLUTION OF SOME PROBLEMS OF TECHNICAL DIAGNOSIS OF RADIO ELECTRONIC EQUIPMENT BY MACHINE METHODS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 6, Jun 80 pp 101-103 manuscript received 10 Apr 79; after revision 8 Oct 79

MARTYNENKO, O. N. and SERDAKOV, A. S.

[Abstract] A method is proposed for solution on a computer of three problems which arise during accomplishment of technical diagnosis of radio electronic equipment. The program developed during its solution consists of three parts, each of which corresponds to one of the problems. The program can be used not only during diagnosis of radio electronic equipment, but also in principle for all other objects of diagnosis which can be represented by a functional model and for which tolerance control is acceptable. During this the number of functional elements and the connection between them is limited only by the memory capacity of the computer used. Figure 1; references: 3 Russian.
[295-6415]

UDC 621.396.931

IMPROVEMENT OF THE NOISE REJECTION OF ADAPTIVE TELEMETRY SYSTEMS ON THE BASIS OF ZERO EXTRAPOLATION AND MALFUNCTION CORRECTION

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 75-77 manuscript received after completion 9 Jul 79

ZHURAVIN, L. G., MARINENKO, M. A. and SEMENOV, Ye. I.

[Abstract] Polynomials of the zero or first degree are used for approximation of the signal in modern adaptive telemetry systems with time-division multiplexing. In systems of this sort it is possible to improve transmission fidelity by the rejection of readings of a signal affected by interference at work in the communications channel. In zero extrapolation and with the absence of malfunctions in the communications channel, the values of near readings always differ from one another by the amount of the permissible approximation error, ε_d. Errors in symbols in coded messages result in discrepancies in differences of near readings, Δx, from the value of ε_d. To reduce the error from malfunctions it is feasible to compare each difference, Δx, with a certain setting, $k\varepsilon_d$, where the value of k depends on the specific algorithm used. The reading which arrives is accepted if $\Delta x \leq k\varepsilon_d$, and otherwise this reading is rejected and is replaced by the extrapolated value, or the previous accepted reading. This method has the advantage over other methods of rejecting false readings that it is not necessary to broaden the communication channel's frequency band and to use complicated equipment. The question is discussed here of completing the correction of malfunctions by minimizing the root-mean-square error from malfunctions on account of the optimal distribution of energy for message symbols. An analysis and data are presented which demonstrate that a fundamental gain in noise rejection is achieved by means of the correction of malfunctions and the optimal distribution of energy between symbols results in an additional gain in terms of variance of 1.5- to 4.46-fold. It is assumed that an elementary message contains an address code and a readout code and that a readout code consists of $n_1 + n_2$ bits, of which n_1 bits (the lowest) are not corrected and therefore must be transmitted by means of signals with non-identical energy. Errors in the n_2 upper bits of the readout code are rejected at the receiving end and consequently result in the manifestation of identical errors caused by rejection of the reading. These n_2 bits must therefore be transmitted by means of signals with identical energy. Address code bits, n_3, must also be protected to an identical degree from the influence of noise in the communications line. It is demonstrated that the total error caused by errors in the readout and address code combination consists of three components. An equation is presented for the total variance of all particular errors from malfunctions for statistically identical useful signals. The variational problem is solved of finding the optimum, in terms of the minimum root-mean-square error resulting from malfunctions, distribution of the total energy of the code combination bit by bit. References: 6 Russian.

[282-8831]

UDC 681.3

CONCERNING SOME ALGORITHMS OF SIGNAL PROCESSING REALIZED BY RAPID FOURIER TRANSFORMATION

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23, No 6, Jun 80 pp 52-56 manuscript received 2 Jul 79

KUKHAREV, G. A. and TUPIKOV, V. D., Institute of Precision Mechanics and Optics

[Abstract] The paper considers new forms of representation of algorithms in such problems of signal processing as interpolation, filtration, signal compression and modelling (approximation) of spectra, oriented to the mathematical apparatus of a rapid Fourier transformation. A matrix form of representation of such algorithms is presented, suitable for processing in a computer with parallel organization of the computing process, and in the construction of computing devices and systems. In order to realize the algorithms considered, the computing procedures of a rapid Fourier transformation are proposed, which differ from known structures by the method of forming the matrix of factors and the generalization of the procedures for the case of an arbitrary basis r and the bases of discrete exponential functions, rapid Fourier transformations, and Wallis' functions. A table shows the maximum computing expenditures for the proposed algorithms as compared with known approaches. Table 1; references: 3 Russian. [293-6415]

CERTAIN ASPECTS OF PHOTOGRAPHY, MOTION PICTURES AND TELEVISION

UDC 621.317.799:621.397

AUTOMATIC MEASUREMENT OF THE PARAMETERS OF A TELEVISION SIGNAL AND THE QUALITATIVE INDICES OF A TELEVISION CHANNEL

Moscow ELEKTROSVYAZ' in Russian No 5, May 80 pp 17-32 manuscript received 19 Dec 79

KRIVOSHEYEV, M. I., DVORKOVICH, V. P., BABICH, V. V. and RYVKIN, V. V.

[Abstract] The principal methods, both in the USSR and abroad, for automatic measurement of the parameters of a complete color television signal and the qualitative indices of the television channel are considered. These methods are realized in the new K2-35 measurer, for which a description and a block diagram are presented. Algorithms and methods of processing the distortions of the measuring signals are cited. A multipage table lists the following: 1) The magnitude measured and the source of information; 2) The form of the signals up to and after analogous processing; 3) Points of measurement and their position in the television signal; 4) Algorithms of processing and calculation of the magnitudes measured; 5) Number of readings with digital averaging; 6) Random and systematic component errors; and 7) Time of measurement (seconds). Problems of assuring a high precision of measurement with a sufficient speed of response are considered. The overall measuring time by the K2-35 measurer of all the basic parameters of a complete color television signal and the qualitative indices with the indication time taken into account is on the order of 1 min 40 sec. A number of technological possibilities for the measurer are listed and a photograph of it is presented. Figures 6; table 1; references 14: 7 Russian, 7 Western. [280-6415]

CERTAIN ASPECTS OF RADIOASTRONOMY, SATELLITES AND SPACE VEHICLES

UDC 621.396.946:621.396.6

TRANSMISSION OF INFORMATION IN DISCRETE FORM BY SATELLITE COMMUNICATION SYSTEMS

Moscow ELEKTROSVYAZ' in Russian No 5, May 80 pp 12-16 manuscript received 5 Feb 80

KANTOR, L. Ya., KOROBKOV, L. A., KOKOSHKIN, V. P. and TSIRLIN, V. M.

[Abstract] An analysis is made of methods for transmission of information in discrete form by satellite communication lines. The two types of multistation access--frequency and time--most widely used in USSR satellite telephone networks are compared. The terminal apparatus "Kareliya-S" and "Kareliya-SM" used for operation with these types of frequency and time multistation access are described and various speeds of the digital flow at the output of the terminal apparatus are cited. The advisability is shown of transmitting information in discrete form in the case of both frequency and time multistation access. Figures 3; references: 12 Russian.
[280-6415]

UDC 621.372

REALIZATION OF SUBCIRCUIT METHOD DURING SYMBOLIC ANALYSIS OF LINEAR CIRCUITS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 6, Jun 80 pp 21-25 manuscript received 26 Feb 79; after revision 20 Jul 79

BEREZKO, L. A. and SHAPOVALOV, Yu. I.

[Abstract] In order to increase the effectiveness of machine analysis of complex electronic circuits, separation of circuits into subcircuits is used, with a subsequent combination of the results of an analysis of each of them. Subcircuits are understood to be parts of the circuits both coinciding and not coinciding with the functional units (blocks) of the original circuit. The present paper considers the necessity for automation of separation of circuits into subcircuits and the choice of the sequence of couplings of these subcircuits. Solution of this problem is of current interest in various methods of analysis (numerical, numerical-symbolic, symbolic), and is especially important during realization of algorithms using a topological description of circuits. Criteria are proposed for separation and coupling, which make it possible to reduce the time for obtaining alphanumerical expressions for circuit functions threefold as compared with the AS-7 program. Figures 3; references: 5 Russian.
[295-6415]

UDC 621.372

APPROXIMATION ACCURACY ANALYSIS OF CIRCUIT FUNCTIONS IN THE CASE OF A LARGE DISPERSION OF COMPONENT PARAMETERS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 6, Jun 80 pp 45-49
manuscript received 5 Apr 79; after revision 6 Jul 79

PAVLOV, L. N. and KALNIBOLOTSKIY, Yu. M.

[Abstract] The precision of approximation of the circuit functions of electronic circuits is investigated with the aid of the Wallis-Taylor series which converges with absolute exactness at points where the magnitude of the variation of components is equal to the test deviation. The problem of the precision of approximations by a Wallis-Taylor series with variation of the components over a large range of values is also investigated. Members of a Taylor series are used to obtain relations which express the approximation error. A mixed Wallis-Taylor series is proposed in order to minimize the approximation error. Figures 2; references: 6 Russian.
[295-6415]

UDC 621.372.061

COMPARISON OF PROGRAMS OF CIRCUITRY DESIGN ON THE BASIS OF A SET OF TEST PROGRAMS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 6, Jun 80 pp 5-12
manuscript received 10 Dec 79

PETRENKO, A. I., TIMCHENKO, A. P. and SLYUSAR, P. B.

[Abstract] Test problems are examined which were used in 1975-1977 by G. W. Zobrist and J. C. Bowers of the University of Southern Florida, during a comparative investigation of the foremost programs of circuitry design widely used at that time in Western Europe and the USA. It was considered advisable to conduct an evaluation of these tests with the aid of USSR applied program packets (PPP) oriented to the solution of problems of circuitry design, in order to have the opportunity to compare the results of functioning programs for analysis of radio engineering circuits developed in the USSR and USA from the point of view of the feasibility of the algorithms used in them. The PPP SPARS is intended for solution on a YeS computer of a wide range of problems which originate during development of the principal electrical circuits of radio engineering devices. SPARS

makes it possible to conduct a thorough investigation of a large number of items such as linear and nonlinear circuits in a static mode. The results of the investigations are presented in seven tables. It is concluded that on the basis along of a comparative solution of the test problems, it is difficult to draw a conclusion concerning the most effective program. Nevertheless, a definite evaluation of the quality of a program in such a comparative analysis has an effect. During comparison it is necessary to assure the objectivity of obtaining a solution of the test problems so as to be free from individual adjustment of the program to the solution of a concrete problem. The description of the test problems presented in this paper, together with data concerning the characteristics of a number of programs, makes it possible for interested developers and users of other USSR programs of circuitry design to evaluate their feasibility. Figures 8; tables 7; references 5: 3 Russian, 2 Western.
[295-6415]

UDC 621.372.061

MACROMODELLING OF DIGITAL AND PULSE CIRCUITS USING MACROELEMENTS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 6, Jun 80 pp 13-20
manuscript received 6 Mar 79

BAKHOV, V. A.

[Abstract] At present two factors limit the use of macromodelling: 1) The nomenclature of the series of integrated circuits produced is extremely wide, is continuously supplemented, and apparently not one program of electrical computation can be equipped sufficiently completely by the library of macromodels; and 2) Users of the programs seldom have available the opportunities and the qualifications for replenishment of the library of models for programs necessary for the needs of a design assortment. The present paper proposes a procedure for macromodelling of digital and pulse functional units of integrated circuits which does away with these two limitations. The essence of the procedure consists in the use for macromodelling of a limited collection of models of electrical components called macroelements, with the aid of which it is possible to model such units as "AND-NOT" and "OR NOT" gates, multivibrators, nonstable multivibrators, triggers and the circuits produced from them, such as "AND-OR-NOT," registers, decoders, counters and so on. The paper is devoted to the basic creation of the logical-functional part of macromodels from macroelements which in essence replaces writing of the algorithm of a macromodel in a programming language. The user thereby has an opportunity to expand without restriction the library of macromodels in accordance with requirements.

Descriptions are given of work on the following units: 1) "AND-NOT" gate; 2) Timing D-trigger; 3) Timing two-stage J-K trigger; 4) Nonstable multivibrators; and 5) Multivibrators. With proper organization of a collection of macroelements, macromodelling with their aid coincides in precision and is not inferior in speed of calculation to the method of realization of macromodels in the form of subprograms, only losing out in the length of the input information, and with the given possibilities, programs are also not inferior with respect to convenience of us. The proposed procedure can be realized in any program of electrical calculation of circuits. Figures 6; references: 2 Russian.
[295-6415]

COMMUNICATIONS, COMMUNICATION EQUIPMENT, RECEIVERS AND TRANSMITTERS, NETWORKS, RADIO PHYSICS, DATA TRANSMISSION AND PROCESSING INFORMATION THEORY

UDC 621.3.037.372

SOME POSSIBILITIES OF INCREASING THE SENDING SPEED OF DISCRETE MESSAGES IN COMMUNICATIONS SYSTEMS UTILIZING MORSE CODE

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 73-74 manuscript received 25 Apr 79

BASHTIN, N. A. and BASHTIN, A. N.

[Abstract] It is demonstrated that by redistributing the existing code combinations in communications systems utilizing Morse code, taking into account the individual probabilities of graphemes for the English language, it is possible to use on average 4.62 elementary messages for a single transmission signal instead of the 4.969 used at the present time. This represents a gain of seven percent in terms of code economy. For Russian the gain in terms of code economy equals, respectively, 12, 12.2, 12.3 and 12.5 percent, depending on the nature of the text analyzed. Figures are shown, illustrating the degree of utilization of letters, taking into account the number of elementary messages by which letters of the Russian and English alphabets are coded at the present time. These are compared with a suggested coding variant making it possible to achieve maximum economy of Morse code utilization. An equation is presented, which determines the mean necessary time spent for the transmission of a single signal by Morse code. It is demonstrated that the duration of a single elementary message depends not on the coding method, but only on the level of the operator's skill and that therefore for achieving maximum code economy it is necessary to code in such a manner that the minimum number of elementary messages is used for a signal. This is achieved only when graphemes with the greatest individual probability are coded by combinations having a minimum number of elementary messages. The Morse code is in many instances irreplaceable because of the fact that with an operator of sufficient experience it is possible to distinguish signals against a background of considerable noise interference. The employment of a method such as this for increasing the message transmission rate in systems in which the code is used is therefore important. It is shown that by substituting certain letters of the Russian alphabet by others when sending and then reversing the process at the receiving end it is possible to increase the carrying capacity of a channel by seven percent. Figures 2; references: 2 Russian.
[282-8831]

UDC 621.372.632

FORMATION OF ULTRAHIGH-FACTOR HARMONICS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 50-53 manuscript received 26 Jun 79

BESKIN, L. N.

[Abstract] Multipliers are used to produce the k-th harmonic of a continuous signal, cos ωt. When k has a high factor, elementary units are usually connected in cascade fashion, but it is necessary that k be factored into the product of several cofactors for which these units are technically realizable. If k [illegible] high simple number it can be represented as a sum, i.e., k = k' + k" [illegible] the frequency can be multiplied by k' and k" in two parallel channels and the frequencies obtained can be added. A discussion is given here of the optimal design of a multiplier of this type when the k factor is high and inconvenient from the viewpoint of technical feasibility. The method is based on Goldbach's classical statement that any even whole number, k, represents the sum of not more than two simple numbers. The problem is discussed of factoring whole number k into the sum of two addends, k' and k", which are integral to the maximum degree. For example, if k = k' + k", k' = $k'_1 \ldots k'_m$ and k" = $k''_1 \ldots k''_n$ represent factoring of the addends into simple cofactors, whereby $k'_1 \le \ldots \le k'_m$ and $k''_1 \le \ldots \le k''_n$. Also, p = max ($k'_i$, k''_j) represents the maximum of all cofactors of both expansions. Expansion k = $k'_0 + k''_0$ is considered the optimal when in considering all possible expansions of the kind k = k' + k" the number p reaches a minimum of P_0. Here P_0 represents a certain function of k ; $P_0 = \phi(k)$. For k = 43 the optimal expansion is found of 43 = 16 + 27, whence $\phi(43) = 3$. The algorithm for finding the optimal expansion is very simple to run on a computer. Tables of optimal expansions are presented. Optimal factoring of the required multiplication factor, k, results in the simplest structure for a k-factor multiplier when in two parallel channels multiplication is accomplished by a factor of k'_0 and k''_0 and the output frequencies of these channels are summed. The elementary units used in each parallel channel do not contain factors higher than $P_0 = \phi(k)$. The resulting structure contains elementary multipliers with the lowest possible multiplication factors and a total of one adder. Difficulties which arise in practical implementation are discussed and methods of surmounting them are offered. One of these is when the optimal expansion of k can contain a low addend of k'_0 or k''_0, whereby the frequencies at the output of the mixer are difficult to distinguish from one another; for example, k = 641 has an optimal expansion of 1 + 640 with $P_0 = 5$ and therefore harmonics with numbers of 641 and 639 compete. For this purpose conventionally optimal factors are given. Tables 2; references 3: 2 Russian, 1 Western.
[282-8831]

UDC 621.391.144

CORRELATION FUNCTIONS OF MULTIPHASE SIGNALS AND QUADRATIC FORMS OF MANY VARIABLES

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 68-70 manuscript received after completion 22 Aug 79

ZHITKOV, V. V.

[Abstract] It has been demonstrated previously (1963, 1965) that multiphase signals, i.e., phase-manipulated signals with a number of phase gradations of $p > 2$, exist which have good correlation properties and that with regard to their characteristics multiphase signals of higher orders have advantages over binary phase-manipulated signals of the same length. It is difficult to study the correlation properties of these signals because it is necessary to work with complex numbers in calculating the correlation functions of multiphase signals. When $p = 2$, for the purpose of calculating the correlation functions of binary phase-manipulated signals it is possible to use the equation $R = 2h_0 - 1$, where h_0 is the frequency of agreement of elements between code sequences. Here similar equations are derived for the purpose of calculating the correlation functions of multiphase signals. A phase-manipulated signal with a number of phase gradations of b is defined completely by the code sequence, which is written in the form of a vector of length N. An equation is presented for the correlation function of phase-manipulated signals, which are represented by two vectors. The computation of correlation functions reduces to the construction of a Gram matrix followed by the summation of elements along the matrix's diagonals. An equation is presented for the purpose of formalizing the determination of correlation functions by means of a Gram matrix. The case of computing a periodic correlation function is discussed. Calculation equations for correlation functions for the first few values of p are presented in a table. It is demonstrated that the set of values of correlation functions of multiphase signals is determined by the set of values of the p-dimensional quadratic form. Furthermore, correlation functions take on their lowest values with a certain structure of vector z_m, representing the sequence of elements of the Gram matrix with a number of m placed along a codiagonal. It is thus demonstrated that there is a relationship between the correlation functions of multiphase signals and the quadratic forms of many variables. Figure 1; references 4: 3 Russian, 1 Western.
[282-8831]

UDC 621.391.828 : 621.39.08

SELECTION OF PARAMETERS OF COMMUNICATIONS COMPLEX RADIO RECEIVERS ACCORDING TO THE ELECTROMAGNETIC COMPATIBILITY CRITERION

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 53-55 manuscript received 5 Jun 78

SILIN, A. V. and SAMARIN, V. P.

[Abstract] A mathematical model in the form of a set of systems of inequalities is presented for the undesirable interaction of radio equipment of a communications complex. This system of inequalities determines the required ratio between levels of noise at work in the input of the i-th receiver and their permissible values determined by the multisignal selectivity characteristic. This system can at the same time be used as the reference system for selecting the electromagnetic compatibility parameters of the receiver, i.e., the dynamic range of the receiver, D, and parameter N_2, which determines the behavior of the multisignal selectivity characteristic in a neighboring channel. Equations are derived for the selection of D and N_2. Receiver parameters are selected in terms of electromagnetic compatibility by determining the minimum values of D_i and N_{2i} satisfying specific conditions, where D_i is the dynamic range of the i-th receiver in relation to intermodulation and N_{2i} is the rate of growth of the multisignal selectivity characteristic of the i-th receiver with high frequency differences. The problem is formulated as a linear programming problem which is solved graphically. The condition for electromagnetic compatibility can be fulfilled only with a certain degree of probability. The problem of selecting the electromagnetic compatibility of the receiver's parameters is presented as a problem of stochastic programming with a linear special-purpose function which must be minimized by taking into account limitations with regard to probability. The theoretical notions developed are applied to the most often encountered case where each radio unit has been assigned several operating frequencies which are used with a specific degree of probability. Each receiver is assumed to operate at one assigned frequency with a specific probability and each transmitter operates at one operating frequency, also with a specific probability. It is stressed that it is possible to arrive at substantiated requirements for the electromagnetic compatibility parameters of receivers in a communications complex only by taking into account the specific conditions of the receivers' operation. The procedure described here for selecting parameters can be used only when the designer has a priori information in the form of knowledge of the radiation characteristics of transmitters, of frequency differences between receivers and transmitters and of the amount of decoupling between the inputs of receivers and outputs of transmitters. Parameters arrived at in the manner described make it possible to lower the real sensitivity of receivers resulting from the interfering effect of neighboring transmitters by no more than a factor of two. Figure 1; references: 4 Russian.
[282-8831]

UDC 621.394.69

COMPLEX EQUIPMENT FOR AUTOMATION OF TRANSMISSION OF CURRENT TIME ON TELEGRAPH NETWORK OF SUBSTATIONS

Moscow ELEKTROSVYAZ' in Russian No 5, May 80 pp 45-47 manuscript received 14 May 79

MARTSENITSEN, S. I., VRAZHNOV, V. N., BALANOVSKIY, L. I., DZYUBA, A. N. and KUTASEVICH, V. P.

[Abstract] The Odessa affiliated branch of the Central Design Bureau (TsKB) and the Kiev division of the Central Scientific-Research Institute of Communications developed and introduced the following automated complex of apparatus into series production at the Odessa plant "Promsvyaz'": 1) Equipment "Chas" [hour], the time assigning part of an automated complex for transmission of current time through a network of substations; 2) Equipment "Vremya" [time], the subswitching and monitoring part; and 3) The individual subswitching device UPI-chas, the automated device for subswitching to the switchboards of lower-echelon service. A block diagram of the "Vremya" equipment and the principles of its operation are reviewed. The expenditure of time during automatic transmission of current time is decreased considerably as compared with the existing manual method. Figures 3; references: 2 Russian.
[280-6415]

UDC 621.396.4

OPERATING EXPERIENCE FOR TTsUMS-5 RADIO RELAY TRUNK LINES

Moscow ELEKTROSVYAZ' in Russian No 4, Apr 80 pp 47-48

BARTEL'S, E. O.

[Abstract] Operating experience for the TTsUMS-5 radio relay trunk line is considered. The following are among the many tasks accomplished in updating equipment. In the case of the TTsUMS-5 it was necessary to organize a planning and design division (PDD) and to staff it with qualified engineer-technical workers. A group of antenna-mast specialists was organized in order to carry out installation and reconstruction of antenna-waveguide channels. Of the projects of the PDD, reconstruction has been made of several radio relay lines (RRL) with replacement of R-60/120 equipment by the R-300 and the R-600 and R-60/120 by the "Rassvet." Modernization was accomplished for the periscopic antenna devices, which made it

possible to use a two-frequency plan of operation of the "Rassvet-2" equipment with the assurance that the coefficient of screening effect of the antenna systems is not worse than 60 db. The electrical indices of the trunk lines after reconstruction made it possible to organize 600 time-frequency (TCh) channels with the utilization norms accepted in the USSR. Much work was done with respect to utilization of the R-300 equipment produced by the Hungarian Peoples Republic. The fittings of the RRL-12 equipment, completely fulfilled by semiconductor devices, were used in a new way to organize a system of operation and maintenance. At present the PDD is reconstructing the RRL-23 where the GTT-4000/600 equipment is replaced by the "Voskhod" and "Rassvet-2." During assimilation of "Rassvet-2" equipment the travelling-wave tubes operated unstably, their average life time amounting to 2000-3000 hours. Complex measures conducted by the TTsUMS-5 laboratory made it possible to increase the lifetime to 8000 hours. With the object of increasing the stability of operation of guaranteed sources of power for the TTsUMS-5, these sources were modernized on all the RRL networks. This paper is based on a report presented at the 1979 Chelyabinsk Seminar On Problems Of Increasing the Quality And Reliability Of The Operation Of Radio Relay Lines.
[261-6415]

UDC 621.396.96:621.391.62

OPTIMIZATION OF DIGITAL SYSTEMS FOR THE INTERCYCLE PROCESSING OF SIGNALS AGAINST A BACKGROUND OF NOISE

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 67-68 manuscript received Oct 79

POPOV, D. I. and KOSHELEV, V. I.

[Abstract] It is demonstrated that although an optimal system for intercycle processing of a signal against a background of a mixture of Gaussian correlated and uncorrelated noise is generally not created on the basis of traditional rejector circuits or band filters, the effectiveness of a quasi-optimal system consisting of a series-connected rejector circuit and band filter whose coefficients are selected according to the parameters of the signal and noise is close to that of an optimal system. A structural diagram of the circuit is shown and equations are presented for the coefficient of noise transmission through the rejector circuit and for the improvement factor in the signal-to-noise ratio, characterizing the effectiveness of the quasi-optimal circuit as a whole. Vector analysis is employed to describe the circuit and optimization parameters. Graphic results demonstrate that a quasi-optimal circuit designed on the basis of a

rejector circuit and band filter with coefficients which are optimal in terms of the coefficient of noise transmission through the rejector circuit and the signal-to-noise ratio improvement factor is nearly as effective as an optimal system as the order of magnitude of the rejector circuit increases and the value of the normalized difference in the Doppler phase of the signal and noise approaches π. The order of magnitude of the rejector circuit is determined by parameter λ, i.e., the ratio of the uncorrelated component of the noise to the correlated. An increase in the share of the uncorrelated component in the noise spectrum reduces possibilities for rejection. With a further increase in λ the need for a rejector circuit drops and ultimately the quasi-optimal system realizes optimal operations of stable coherent summation. Figures 3; references 3: 2 Russian, 1 Western.
[282-8831]

UDC 681.325.3/.5

TO THE PROBLEM OF ASSURING ACCURACY OF A SCALING NUMBER-PULSE CODE TRANSLATOR

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23, No 6, Jun 80 pp 57-61 manuscript received 15 Dec 78

KONYUKHOV, N. Ye. and MAYER, A. B.

[Abstract] The circuit is considered of a number-pulse translator, matching scaling with the operation of code translation, and a procedure is shown for determining for it the instrumental errors resulting from the limitedness of the word. The translator circuit and the procedure described were used in a system of digital presentation of the binary 16th digit order numbers with the possibility of their scaling ($K = \frac{1}{15} \div 15$). The system includes a number-pulse translation of binary code into a binary coded decimal system. The paper was recommended by the Department of Radio Engineering, Kuybshev Aviation Institute imeni Academician S. P. Korolev. Figures 2; references: 3 Russian.
[293-6415]

COMPONENTS AND CIRCUIT ELEMENTS, WAVEGUIDES, CAVITY RESONATORS AND FILTERS

UDC 621.372.54

STRUCTURE SYNTHESIS OF A DIGITAL NARROW-BAND FILTER USING SECONDARY DISCRETIZATION

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23, No 6, Jun 80 pp 32-38 manuscript received 19 Sep 79

VITYAZEV, V. V. and STEPASHKIN, A. I.

[Abstract] A significant decrease of the bandpass of a digital filter (index of narrow bandness of digital filter $\beta \ll 1$) with conservation of the index of rectangularity α at a specified level (α=constant) leads to a decrease of the width of the transition zone of the amplitude-frequency characteristic N and, as a consequence, to a significant increase of N. This limits the possibility of using ordinary methods of non-recursive filtration for synthesis of a digital narrow-band filters. The present work examines the synthesis of one- and two-stage structures of a digital narrow-band filter with a finite duration of the pulse characteristic by using secondary discretization, for which the above limitation is not so important. A comparison is made of two realizations of a digital filter. The results are presented of a calculation of the required number of multiplication operations and the capacity of the main memory for each unit, respectively, for the one- and two-stage structure with an optimum value of the parameter M (number of reference functions). The paper was recommended by the Department (Kafedra) of Automatics and Telemechanics, Ryazanskiy Radio Engineering Institute. Figures 3; references 2: 1 Russian, 1 Western. [293-6415]

UDC 621.372.54.037.372

PROBLEMS IN IMPLEMENTING NONRECURSIVE NARROWBAND DIGITAL FILTERS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 47-50 manuscript received 19 Dec 79

VITYAZEV, V. V., KOLYADKO, D. I. and STEPASHKIN, A. I.

[Abstract] In an earlier study (1977) by V. V. Vityazev and A. I. Stepashkin a method was described of creating digital narrow-band filters which was based on redigitization of the output signal. This method is effective from the viewpoint of the amount of computations and the cost of implementing a narrow-band filter which is tunable in terms of the mid-range frequency and passband. Implementing a bank of digital band filters covering a certain frequency range of $2\omega_s$ in terms of the mid-range frequency of ω_{os} requires an increase in individual costs proportionate to the number of filters, i.e., $R = 2\omega_s/\Omega$ where Ω is the passband of an individual filter. Here a method is suggested for creation of the structure of a bank of digital band filters which minimizes this disadvantage. The filter bank discussed is for a frequency selection system for a polyharmonic signal against a background of polyharmonic interference and fluctuation noise. The method consists in isolating and subsequently solving the problems of smoothing the fluctuation noise and of frequency selection of the polyharmonic signal by means of a cascade connection of a band filter digitizer with a passband of $\omega_{eff} \geq 2\omega_s$ and a signal frequency divider operating at the digitization frequency for the incoming signal, $\omega_{kv_2} = 2\pi/T_2 \geq 2\omega_{eff}$. A band filter interpolator is provided for the purpose of restoring the mid-range frequency and intermediate readings of the filtered signal in the output of the signal frequency divider. The algorithm for operation of this two-stage structure is described by the following sequence of operations: 1) Quadrature modulation of the incoming signal, making it possible to reduce the problem of band filtering to the problem of low-frequency filtering of a complex signal; 2) Low-frequency filtering of the signal with channeling of readings of the signal at the output of the digitizing filter; 3) Frequency selection of components of the polyharmonic signal in the input of the signal frequency divider; 4) Classification of the R components and formation of the output signal for the signal frequency divider; 5) Restoration of intermediate readings of the signal by means of a filter interpolator with a pulsed characteristic; and 6) Quadrature modulation of the signal, transferring the spectrum of the filtered signal into the region of the mid-range frequency. Two methods of implementing the structure are compared and a general functional diagram is presented of the two-stage structure. Technical characteristics are given of specific filters based on integrated circuits with a medium level of integration. Figures 2; references 4: 2 Russian, 2 Western.
[282-8831]

UDC 621.372.831

THIN DIAPHRAGMS IN WAVEGUIDES WITH A CROSS SECTION OF COMPLEX SHAPE

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 83-86 manuscript received after completion 2 Jan 79

SINYAVSKIY, G. P.

[Abstract] A study is made of thin diaphragms in waveguides of complex shape. Investigation of this problem is complicated by the fact that in these waveguides there is inhomogeneity of electromagnetic fields of all types of waves including the principal, H_{10}, along the coordinate axis of electromagnetic fields. When the H_{10} wave strikes an inductive or capacitive diaphragm in a waveguide of complex shape, the entire spectrum of H and E waves is excited, as a result of which any diaphragm can be a resonant diaphragm. It is therefore necessary to make an analysis on the basis of vector wave fields. An infinite waveguide is discussed with a cross section of S_b and an infinitely thin ideally conducting diaphragm with an aperture of arbitrary shape, S, placed in plane $z = 0$. Only the principal H wave is propagated in the waveguide remote from the inhomogeneity. Equations are given for the total electric field in the waveguide in front of the diaphragm and in back of it. A functional is arrived at for the shunt conductance, which is represented in the form $B = B_C + B_L$, where B_C is of a capacitive nature and is determined by E waves and B_L is of an inductive nature and is determined by unpropagated H waves. The use of this functional for calculating diaphragms in a channel-bar waveguide is discussed. Equations are derived for z components of the magnetic field for H waves and z components of the electric field for E waves. An equation is presented for the electric field in the diaphragm's aperture. By utilizing the expressions derived for the fields and the relationship between components of the electric and magnetic fields in the waveguide, expressions are arrived at for the shunt conductance of capacitive and inductive diaphragms in a channel-bar waveguide. The results are given of a calculation of capacitive diaphragms and inductive diaphragms in a standard channel-bar waveguide with a 2.4:1 transmission band. Calculated values of the shunt conductance of a diaphragm were compared with experimental results. The experimental accuracy was seven percent. The theoretical results are shown to agree well with the experimental, in a first approximation. Figures 3; references: 8 Russian.
[282-8831]

NEWS OF INSTRUMENT TECHNOLOGY

Moscow RADIO in Russian No 4, Apr 80 pp 44-45

BORNOVOLOKOV, E., Zhitomir-Moscow

[Abstract] Conducting scientific-technical conferences is one of the good traditions of the Zhitomir Production Association "Elektroizmeritel'" [Electrical Measuring]. On the base of this Association, an All-Union Conference devoted to improvement of the technical parameters of general-purpose instruments was held for 3 days at the end of last year. During the conference, 174 papers were read in five sections and at two plenary sessions. The papers and communications not only touched upon problems of improvement of the technical parameters of general-purpose measuring instruments but also ways to create perfected new methods of measurement with the use of the latest achievements of circuitry and the newest elements base. The following specific examples of work on instruments are mentioned. During development of a new measuring instrument, a digital battery multimeter, a group of coworkers of the L'vov Polytechnical Institute obtained 40 patents. A new measuring instrument used to monitor and observe electrical signals through insulating cover without contact with current-conducting connections and without damage or disconnection was developed by VNIIEP (All-Union Scientific-Research Institute of Electrical Measuring Instruments) in Leningrad, together with the Zhitomir Productions Association "Electrical Measuring." With the use of such an instrument measurement and oscillographing is possible of pulsed and harmonic voltages from 0.1 to 10 V, pulsed current from 1 to 90 mA at frequencies from 1 Hz to 500 kHz with a pulse nature of the signal, and with a sinusoidal voltage--at frequencies from 1 Hz to 1.5 MHz. This instrument does not have analogs in world practice. A photograph is shown of the "Kachestvo" [Quality] measuring-computing complex, which is intended for measurement by digital methods of the quality indices of electric power (deviations and oscillations of frequency and voltage, coefficients of asymmetry, unbalance and nonsinusoidalness). The results of measurements are issued on a digital indicator, punched tape and a printer. Figures 2.
[291-6415]

CONVERTERS, INVERTERS, TRANSDUCERS

UDC 621.374.4

CREATION OF IDEAL FREQUENCY MULTIPLIERS AND DIVIDERS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 45-47 manuscript received after completion 14 May 79

BASEVICH, Ya. S. and ZAKHAROV, A. A.

[Abstract] The characteristics of nonlinear elements in frequency multiplication and division equipment which accomplishes "pure" multiplication or division are described by Chebyshev polynomials. There are various methods of implementing these characteristics, but these methods are complex, especially with a high multiplication or division factor. The complexity of the equipment increases with an increase in this factor. This study is concerned with finding a method of ideal frequency multiplication and division which is free of these disadvantages. Because only Chebyshev nonlinear characteristics will ensure "pure" frequency multiplication, the study concentrates on representing and implementing them in a manner in which the disadvantages named will not be present. For this purpose the characteristics are implemented by means of differential equations. The characteristic of an ideal multiplier is written in the form of $y = T_n(x) = \cos (n \arccos x)$, where $|x| \leq 1$, where $x = x(t) = u(t)/U_0$ is the normalized input effect and n is the multiplication factor. A parametric second-order differential equation, i.e., a Chebyshev equation, is used to describe this characteristic: $(1 - x^2)(d^2y/dx^2) - x(dy/dx) + n^2 y = 0$. With an input effect generally in the form of a signal with a variable frequency, $u(t) = U_0 \cos \phi(t)$ and $x(t) = \cos \phi(t)$, the output oscillation for any n can be written in the form $y(t) = A \cos [n\phi(t) + \psi_0]$, where constants A and ψ_0 are determined by the initial conditions. These equations make it possible to implement equipment which will be frequency multipliers or dividers for any factor, depending on n, i.e., they will be multipliers with $n > 1$ and dividers with $n < 1$. The question of the ability to change the multiplication or division factor is discussed and a method is described of avoiding preliminary measurement of U_0. An equation is derived for rewriting the equation for an ideal converter, and a structural diagram is given of a converter which implements the rewritten equation. Equipment based on the equations discussed makes it possible to accomplish "pure" multiplication or division of a variable signal frequency without the byproducts of nonlinear conversion and with any factor, whereby the structure

of the equipment remains unchanged when the factor is changed. This equipment can be implemented without special difficulty in the 0 to 10^5 to 10^6 Hz frequency range. The correctness of the theoretical conclusions was confirmed by an experimental verification. Oscillograms are given of the input and output oscillations of a frequency multiplier with a multiplication factor of 7.5. Figures 2; references: 12 Russian.
[282-8831]

UDC 621.376.2

ANALYSIS OF ERRORS IN CONVERTING BIPOLAR PULSES INTO QUASI-DIRECT VOLTAGE

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 65-67 manuscript received after completion 29 Oct 79

RAD'KO, M. A. and STEPANOVA, L. N.

[Abstract] Pulsed bipolar power supplies are being used more extensively for the purpose of raising the level of the useful signal of parametric transmitters and for improving the signal-to-noise ratio. A discussion is given here of the problem of converting the amplitude of the bipolar pulsed signal into quasi-direct voltage. An analysis is made of the errors originating in this type of conversion and a procedure is given for calculation of the converter's time delay circuits. The bipolar signal is amplified by a preamplifier and is fed to the input of a synchronous detector consisting of a capacitor and switch, which converts the peak-to-peak amplitude of the input signal into a pulsed unipolar voltage. The output voltage of the synchronous detector, equaling 2KU, where K is the amplifier's gain and U is the voltage corresponding to the flat section of the peak of the input pulse, is stored, during the arrival of a control pulse, by an analog storage unit after the switch of the synchronous detector is opened. When a second switch is closed, a second capacitor is charged to a voltage equal to the output voltage of the synchronous detector. When this second switch is opened by the second capacitor, the stored voltage is sent to the output of the converter. The conversion error is determined by the recharging of the capacitors of the synchronous detector and analog storage unit, by a difference of the analog storage unit's transfer constant from unity and by zero drift of the analog storage unit's operational amplifier and follower during closing of the negative feedback loop. The origin of these situations and how to correct them are discussed. Errors can be reduced to a minimum by the proper design of the time delay circuits in the converter. Figures 3; references: 1 Russian.
[282-8831]

UDC 621.372.8

TAKING INTO ACCOUNT ANOMALIES OF ELECTROMAGNETIC FIELDS IN THE METHOD OF FRACTIONAL REGIONS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 27-34 manuscript received 21 Sep 79

VESELOV, G. I., PLATONOV, N. I. and SLESAREV, Ye. S.

[Abstract] The method of fractional regions has become widely used in solving a wide range of diverse problems in electrodynamics. Its simplicity and universality make it possible to construct effective algorithms for calculating the dispersion characteristics of various structures, coefficients of reflection from inhomogeneities and other characteristics of electromagnetic fields. The existence of field anomalies at the interface of regions results in worsening of the method's convergence. Difficulties are encountered in plotting fields near points of geometric singularity. The convergence of the method can be improved considerably and it is possible to calculate fields with an anomaly by re-expanding the components of fields having anomalies at the interface of regions into a series in terms of the entire system of functions, $\{\phi_n\}$, each of which has a specific anomaly. Various methods have used as this system of functions Chebyshev polynomials, Gegenbauer polynomials and Bessel functions. [A. S. Il'inskiy and V. V. Zarubanov. Report at seminar of MIREA (Moscow Institute of Radio Engineering, Electronics and Automatics) in February 1979.] In all these cases the systems of basis functions were selected in order to satisfy the two conditions for satisfying the Meichsner condition at one end of the interval and of satisfying by means of the function or its first derivative the boundary condition at the other end of the interval. When some systems are employed, stable rapidly converging functions are obtained, and when others are used, the algorithms converge considerably more slowly and are less stable. This study is devoted to the problem of creating criteria for the selection of the most optimal basis functions. Conclusions drawn regarding the optimal basis functions for a specific case are illustrated in the example of a structure with a strong anomaly at the boundary of two regions, i.e., a model of a microstrip with an infinitely thin strip conductor. It is assumed that electric or magnetic walls are placed in the planes bounding the structure analyzed. A description is given of the algorithm developed, which was run on a BESM-6 computer. A table of results is given for running the algorithm for the case

when electric and magnetic walls are in specific planes. The conditions are formulated which are to be satisfied by the basis function selected for the re-expansion of fields for the purpose of producing effective algorithms. These are as follows: 1) At the boundary of the interval in which the unknown fields have an anomaly it is desirable to take into account in addition to satisfaction of the Meichsner condition the possibly high number of τ_n; 2) At the end of an interval in which the unknown fields do not have anomalies it is necessary to require the consistency of bases, in the sense of satisfying the Maxwell equations, in addition to imposing the usual boundary conditions on each basis function or its derivative; and 3) The bases used for expanding field components must be consistent over the entire range of the union of fields. This makes it possible further to improve convergence and to improve the stability of the algorithm. This work was reported at a seminar of the MGP NTORES [Moscow Municipal Board, Scientific-Technical Society of Radio Engineering, Electronics and Communications imeni A. S. Popov]. Figures 5; tables 1; references 10: 9 Russian, 1 Western.
[282-8831]

GENERAL TREATMENT, INCLUDING POLICY DECLARATIONS, OVERALL STATISTICS, FORECAST OF TRENDS, "THINK PIECES"

COMMENTS BY EDITOR OF IZV. VUZ: RADIOELEKTRONIKA

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 6, Jun 80 pp 3-4

TROKHIMENKO, Ya. K., doctor of technical sciences, professor

[Abstract] In the present issue of the journal, as in the June issues of former years, publication is continued of material concerned with the use of computers for automatization of the development and production of radio-electronic equipment. The existing fund of machine programs for solution of the basic problems of circuitry design is continuously supplemented. However, a relative evaluation of the quality and, consequently, the advisibility of the development and use of such programs is possible only with the availability of well thought out systems of test problems and data concerning the results of their solution by various programs under comparable conditions. Consequently, the opening paper presents test problems for a number of stages of analysis of electronic circuits, which is undoubtedly of practical interest, in spite of the insufficient data concerning the characteristics of the majority of computers. A paper which is useful for developers of systems of automated design of radio-electronic pulse and digital devices presents a procedure for macromodelling integrated structures which makes it possible to replace a library of models of typical integrated circuits by a limited family of standard elements. A number of papers are devoted to problems of analysis of circuits with weak signals. Complex programs of frequency analysis are described. Several papers are devoted to the solution of problems of mathematical modelling and calculation of integrated transistor structures. The problems are complex but of substantial practical interest. Problems of the analysis of nonlinear circuits are considered and a simple procedure for calculation of harmonic distortion factors is described. A number of papers are concerned with automatization of construction design and production of radio-electronic equipment. One paper considers the solution with the aid of a computer of several problems of engineering diagnosis of radio-electronic equipment. The present issue of RADIOTEKHNIKA rather widely presents the results of scientific investigations of various problems in the use of computers during development and production of electronic equipment, which bears witness to the successful development of these fields of knowledge.
[295-6415]

INSTRUMENTS, MEASURING DEVICES AND TESTERS, METHODS OF MEASURING, GENERAL EXPERIMENTAL TECHNIQUES

UDC 62.551.3

VIBRATING LINEARIZATION OF ELECTRIC MEASURING CONTACT INSTRUMENTS

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23, No 6, Jun 80 pp 14-17 manuscript received 11 Jul 79

POPOV, A. S. and FILIN, V. P.

[Abstract] One of the standard representatives of the family of electric measuring contact instruments is considered--the pyrometric regulating millivoltmeter MR-64-02. A new method based on the inertial properties of its movable system is devised for regulating this instrument. The principles of vibration linearization of a regulating millivoltmeter are illustrated. The principal electrical circuit is presented of one of the versions of a linearized regulator based on the MR-6-02. This regulator provided a precision of ± 2°C for laboratory resistance furnaces of various types in the temperature range 400 to 1250°C. A precision of ± 3°C was provided for the vacuum drying cabinet SNVS-4.5.3.4/3-I1 in the temperature range from 30 to 300°C. The paper was recommended by the Department (Kafedra) of Electrical Engineering and Electrical Machines, Tul'skaya Polytechnical Institute. Figures 2; references: 5 Russian.
[293-6415]

UDC 621.317.61

CONTROL OF THE STRUCTURE OF PULSE SPECTRA

Moscow RADIOTEKHNIKA in Russian Vol 35, No 5, 1980 pp 77-81 manuscript received 2 Jul 79

SHEVELENKO, V. D.

[Abstract] Knowledge of features of the structure of modulation spectra is necessary for investigation of the metrological indicators of measuring and converting equipment utilizing features of the amplitude and phase spectra of pulses with variation of their parameters and for the practical implementation of this equipment. The possibility of controlling the structure of spectra should result in improvement in the accuracy of measuring equipment. A study is made here of the structure of a modulation spectrum in terms of the sensitivity of its components to changes in parameters of the pulsed process, using as examples unidirectional pulse width modulation and pulse repetition rate modulation. A train of square pulses modulated according to the law $\tau = \tau_0 + \tau_m \sin \Omega_M t$, with parameters of E, τ, and T, upon the condition that $T_M/T = \omega/\Omega_M = \beta/\alpha$ is a rational number, is represented as the superposition of trains of square pulses with a repetition rate of $F = F_M/\alpha = \Omega_M/2\pi\alpha$ and a pulse length within each train determined by the value of the modulating voltage at the instances of appearance of pulses of an individual train. It is demonstrated that the nature of the spectrum's discreteness is determined by the nature of the multiplicity factor, $T_M/T = \beta/\alpha$. With T_M/T a whole number, the spectrum consists of components whose frequencies are multiples of the modulation frequency, F_M. With T_M/T a fraction, the spectrum consists of two groups of components, whereby the frequencies of one group of components are multiples of the repetition rate, $f = 1/T$, and the frequencies of the other group of components are multiples of the modulation frequency, F_M. The structure of the spectrum is therefore periodic, whereby the difference between individual harmonics of the repetition rate and modulation frequency increases periodically in keeping with a specific law, up to values which are multiples of $F_0 = \alpha f = \beta F_M$. A determination is made of the feasibility of using for measuring purposes specific components of the modulation spectrum, for which a determination is made of the relative amplitude sensitivity of these components to changes in the modulated parameter. It is shown that an important feature of the modulation spectra discussed, with β/α a fraction, is the violation of the equidistant distribution of modulation components relative to harmonics of the repetition rate. Another important feature is the fact that β/α can be less than one. It is demonstrated that the ability to control the distribution of components of the modulation spectra with fractional β/α is predetermined by a reduction in the level of components of the modulation spectra which fall within the selective system's passband in separation of the component being registered. This reduction is conducive to improvement in the accuracy of measuring conversion. Figures 3; references: 5 Russian.

[282-8831]

UDC 681.325.65

METHOD OF AUTOMATIZED RETUNING OF A QUALITY CONTROL UNIT WITH SYMBOLIC DESIGN OF LARGE INTEGRATED CIRCUIT

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 6, Jun 80 pp 64-68
manuscript received 26 Apr 79

RUBTSOV, V. P. and ABBASOV, A. M.

[Abstract] The paper is concerned with automatization of a block for control in retuned systems of automated designing, of one of the technological tolerances--maintenance of the minimum permissible connection between nonequivalent elements of the topological drawing of a large integrated circuit. A procedure is presented for automatization of the preparation of logical equations of control with the object of eliminating manual inspection of logical equations, the structure of which changes with a change of the form and dimensions of constructive-invariant elements and the dimensions of the cells of the reference circuit. It is proposed to replace the process of automatization of the composition of logical equations by the composition of the matrix of connections. A procedure is proposed for use of a matrix of connections for control of concrete symbols of large integrated circuit design. Figures 3; references 6: 3 Russian, 3 Western.
[295-6415]

OPTOELECTRONICS, QUASI-OPTICAL DEVICES

UDC 543.27

SMALL-SIZED MICROWAVE ANALYZER OF GASES-POLLUTANTS WITH AN OPTOACOUSTIC RECEIVER

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23, No 6, Jun 80 pp 75-78 manuscript received 6 Jun 79

GLUSHCHENKOV, V. I., KUZNETSOV, Yu. V. and RUDIN, V. L.

[Abstract] An analyzer was tested by the authors on a number of gases in the 23-26 GHz range with the use of a semiconductor microwave radiation oscillator based on a Gunn diode. In the analyzer, microwave radiation from the Gunn oscillator proceeds through a decoupling attenuator to the radiation-detecting volume of an optoacoustic receiver. The analyzer uses the method of optoacoustic detection based on registration of the changes of the characteristics of the gas (temperature, pressure) under the effect of the microwave radiation. In comparison with detection by a semiconductor microwave diode which notes the change of microwave energy that has passed through the gas, this method records the signal at the zero level, i.e., when outside the absorption line or when gas is absent the signal disappears. In order to increase the absorption, the volume of the radiation detector was made in the form of a microwave oscillator, the magnitude of the loaded Q of which amounted to approximately 7000. The diameter as a function of frequency was equal to 22-25 mm. The concentration sensitivity for several gases is calculated. The paper was recommended by the Department (Kafedra) of Spectral and Opticophysical Devices, Leningrad Institute of Precision Mechanics and Optics. Figures 2; references 5: 3 Russian, 2 Western.
[293-6415]

UDC 62-501.02

DETERMINATION OF CONDITIONS OF ABSOLUTE STABILITY OF RADAR TRACKING SYSTEM

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23, No 6, Jun 80 pp 23-28 manuscript received 3 Jan 79

ZOR'YAN, L. B.

[Abstract] On the basis of the direct method of Lyapunov, the conditions are determined for the absolute stability of a two-channel radar system of automatic direction tracking with successive comparison of signals (conical scanning) which is characteristic of a system of angular tracking with phase-amplitude modulation. The maximum angle of inclination of the nonlinearity of a direction finding device is determined, with which the system is absolutely stable. This makes it possible to synthesize a radar tracking system which assures "lock on" in the case of transition to automatic tracking. The paper was recommended by the Department (Kafedra) of Automatics and Telemechanics, Leningrad Institute of Precision Mechanics and Optics. Figure 1; reference: 1 Russian.
[293-6415]

RECORDERS

UDC 621.372.852

APPARATUS FOR MOVEMENT OF TAPE INFORMATION CARRIER

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23, No 6, Jun 80 pp 44-47 manuscript received 8 Aug 78

GURBANOV, T. B., YUSUF-ZADE, E. M., GUSEYNOV, A. M. and DAVRISHOV, M. G.

[Abstract] One of several structural variations of a tape transport device developed by three of the authors of this paper is further considered. This device has a relatively wide range of control of the movement of the tape, does not have an intrinsic magnetic field and can be successfully used in the input units of computers where information is discretely recorded on a stationary magnetic carrier, as well as in program control by machines where the program is recorded on a magnetic tape information carrier. The device consists of propelling and hold down piezoelectric bimorp elements made of two single-layer plates bonded together by opposite polarization poles in a way so that the vectors of their longitudinal polarization are directed in opposite directions. The operating characteristics of the device are investigated. The paper was recommended by the Department (Kafedra) of Electrical Machines and Electric Drive, Azerbaijan Polytechnical Institute imeni Ch. Il'dryma. Figures 3; references: 3 Russian. [293-6415]

SEMICONDUCTORS AND DIELECTRICS, CRYSTALS IN GENERAL

UDC 621.382.82.001

PROGRAM OF ONE-DIMENSIONAL ANALYSIS OF TRANSIENT PROCESSES IN BIPOLAR TRANSISTORS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 6, Jun 80 pp 55-60
manuscript received 6 Jul 79; after revision 14 Jan 80

MULYARCHIK, S. G., ABRAMOV, I. I. and SOLOV'YEV, V. G.

[Abstract] One of the most economical and effective programs of one-dimensional analysis of transient processes in semiconductor programs is the "DTRAN" program. In the method at the basis of this program each unit of the special partitioning of the structure is characterized by two variables: the voltage of the electrical field E and the concentration of holes p. The present paper proposes an extension of this method, consisting in the use as one of the independent variables the concentration of carriers, minority with reference to the base region of the device. In the case of a p-n-p structure, p and E are variable; in the case of n-p-n structure, n and E, where n is the concentration of electronics--i.e., a change takes place of the formulation as a function of the type of device. This makes it possible to avoid calculating difficulties because of the considerable decrease of scattering of the integrable variables (p or n). Also, in order to increase the speed of response of the program, a formulation of the D. L. Sharfetter--H. R. Gummel type [IEEE Trans.,1969, ED-161,N 1, pp 64-77] is used with an approximation of the current densities. In addition, the implicit formula of H. Shichman [IEEE Trans.,1970,CT-17,N3,pp 378-385] is used during solution of systems of algebra-differential equation. The results are presented of numerical investigations with the use of the developed program of the transient process in bipolar transistors. Figures 3; table 1; references 6: 1 Russian, 5 Western (one in translation).
[295-6415]

UDC 621.382.82.001

COMPUTATION OF ELECTRICAL FIELDS IN INTEGRATED TRANSISTOR STRUCTURES CONTROLLABLE BY CURRENT AND VOLTAGE

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 6, Jun 80 pp 50-54
manuscript received 2 Jan 79; after revision 16 Apr 79

PETROSYANTS, K. O. and RYABOV, N. I.

[Abstract] Modeling of electrical fields resulting from spreading out of currents in the diffusion regions of a semiconductor structure is an effective means of designing the topology of the active and passive components of an integrated circuit, calculation of the resistances of the semiconductor regions of complex configuration, and a number of other problems. Although a number of numerical methods and algorithms have been proposed which make it possible in many cases to solve these problems, all have significant shortcomings. The present paper formulates a general statement of the problem suitable for calculation of semiconductor structures controllable by both voltage and current and free from the limitations of known works. An efficient algorithm of numerical solution is proposed using the quasi-linearization method of Neuton-Kantorovich which has a square-law convergence. This assures better convergence and a substantial gain in machine time with the same outlay of storage of a digital computer. The algorithm is realized in a program composed in the FORTRAN-IV DOS/YeS language for a YeS computer. The program was used for calculation of integrated transistor structures as well as ordinary and "compact" diffused resistors with various topologies. The results of the calculation are presented. Figures 4; references 7: 6 Russian, 1 Western (in translation).
[295-6415]

SYSTEMS ANALYSIS

UDC 621.372.061

ALGORITHMS FOR ANALYSIS OF PROCESSES IN DISCRETE-PHASE STABILIZATION SYSTEMS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 6, Jun 80 pp 92-94
manuscript received 19 Mar 79; after revision 2 Jul 79

SOBOLEV, L. B.

[Abstract] Discrete-phase stabilization systems (DPSS) are widely used as discrete frequency synthesizers as well as highly-precise stabilizers of voltage and speed. In view of the nonlinearity of such systems, an investigation of them by analytical methods is combined with definite difficulties. The present brief report studies the pressing problem of developing algorithms for analysis in DPSS, suitable for programming. Figures 2; references: 2 Russian.
[295-6415]

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